APPENDIX K

FLOOR PROTECTOR THERMAL CONDUCTIVITY CALCULATIONS

(Reference 780 CMR 3610.7.1 and 3610.6.7.1.1)

OVERVIEW

Floor protection requirements for heat producing appliances are typically included as part of the tested/listed installation criteria for such appliances.

Such floor protection, listed as a thermal conductivity factor is often developed utilizing NFPA SUBJECT 1618, "OUTLINE OF INVESTIGATION FOR WALL PROTECTORS, FLOOR PROTECTORS, AND HEARTH EXTENSIONS". (Note that an NFPA SUBJECT is not treated nor maintained in the same manner as an NFPA STANDARD).

When floor protection is developed utilizing NFPA SUBJECT 1618, or developed via "good Engineering Practice", such methodology will typically establish floor protection based on _ inch millboard.

As the thermal conductivity of such millboard can vary from manufacturer to manufacturer, it will be necessary to obtain the thermal conductivity value from a specific manufacturer for a specific millboard product.

Typical thermal conductivity values can range from:

$$k = 0.21 \text{ (Btu) (inch) / (foot}^2\text{) (hour) (°F)}$$

to

$$k = 0.84 \text{ (Btu) (inch) / (foot}^2\text{) (hour) (°F)}$$

Thus the necessity for product specific thermal conductivity.

Note that the lower the algebraic value of "k", the lower the thermal conductivity and the less heat per given time that is transferred across the *floor protector*.

Note that in the following discussions it is necessary to maintain consistent dimensions - i.e.; in dealing with the thickness of materials, do not mix feet with inches, but rather keep all dimensions in inches.

COMPLIANCE

If the manufacturer of the appliance specifies an acceptable material and thickness for floor protection it is necessary, utilizing that specific material with specific thermal conductivity, k, to meet or exceed the thickness specified in order to assure compliance with the listed floor protection requirements of the appliance.

ESTABLISHING EQUIVALENCY

If it is determined that another material of different thermal conductivity is desired to be utilized for floor protection (i.e., perhaps for aesthetic reasons or in order to minimize the thickness of the floor protector) and noting that the thermal conductivity, k, is linear as a function of thickness (for a given single material) then:

$$k_1/t_1 = k_2/t_2,$$

where:

k = thermal conductivity in

$$\text{(Btu) (inch) / (foot}^2\text{) (hour) (°F) and}$$

t = thickness in inches

and therefore knowing any three of the variables of k and t allows one to solve for the remaining variable; i.e., :

Knowing k_1, t_1 and t_2, one can solve for k_2:

$$k_2 = (k_1)(t_2)/(t_1)$$

Knowing k_1, t_1 and k_2, one can solve for t_2:

$$t_2 = (k_2)(t_1)/(k_1)$$

COMPOSITE FLOOR PROTECTOR ASSEMBLIES

When an assembly consists of more than one material, the assembly is defined as a composite "material".

When a floor protector is constructed of more than one material; i.e., some form of backer board with decorative tile over, it is helpful to first establish the thermal resistance, r, of each material as thermal resistances may be directly added together and then convert the resulting total R to an equivalent thermal conductivity.

$$r = \text{(foot}^2\text{) (hour) (°F)/(Btu) (inch) and;}$$

$$R = (r)\ (t)$$

where r is for a particular material in the composite and t is the thickness of that particular material.

Thus for the two-material example of backer board plus decorative tile,

$$R_{\text{total}} = R_{\text{backer Board}} + R_{\text{decorative tile}}$$

and;

$$R_{\text{backer board}} = (r_{\text{backer board}})(t_{\text{backer board}})$$

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and;

$$R_{\text{tile}} = (r_{\text{tile}})(t_{\text{tile}})$$

RELATIONSHIP BETWEEN k AND R

By definition:

$$R = (1/k)(t) \text{ for each distinct material}$$